

Automated Ground Vehicle Systems: Status and Challenges

Panel Session Presentation

FAV Summit

December 1, 2015

Jacksonville, Florida

Charles Reinholtz

Professor and Chair of Mechanical Engineering

Scope and Predictions

- Focus on automated ground vehicles for transportation-related tasks
- Societal changes and safety (product liability) will expedite vehicle automation
- Technology will augment driver capability for at least a generation
- New problems and concerns will emerge as people adapt to the technology

Who Will Learn to Drive in 2030?



<http://www.jokeroo.com/user-content/pictures/funny/2012/8/1027278-learning-to-drive.html>

Social Change: Teens Less Interested in Driving*

- Only 44 percent of teens get a license within a year of reaching legal age
- Just over half of teenagers are licensed by the time they reach 18
- In 1993, 2/3 of teenagers were licensed by the time they reached 18

***2013 AAA Foundation for Traffic Safety report**

US Traffic Fatalities

Insurance Institute for Highway Safety

Year	Fatalities	Vehicle Miles (billions)
1921	13,253	55
1972	54,589	1,259
2005	43,510	2,989
2013	32,719	2,946
2030	0?	3,000?

Basic Principle of Product Liability:

A manufacturer or distributor of a product is liable to compensate a person injured by that product if the product is defective.

But what is a defect?

Product Liability Law

- Meeting a code or standard is not a defense
- Violating a code or standard is negligence
- “State of the Art” is a valid defense

State of the Art: No better design alternative existed

Automation: Electronic Stability Control

Is it Autonomy?

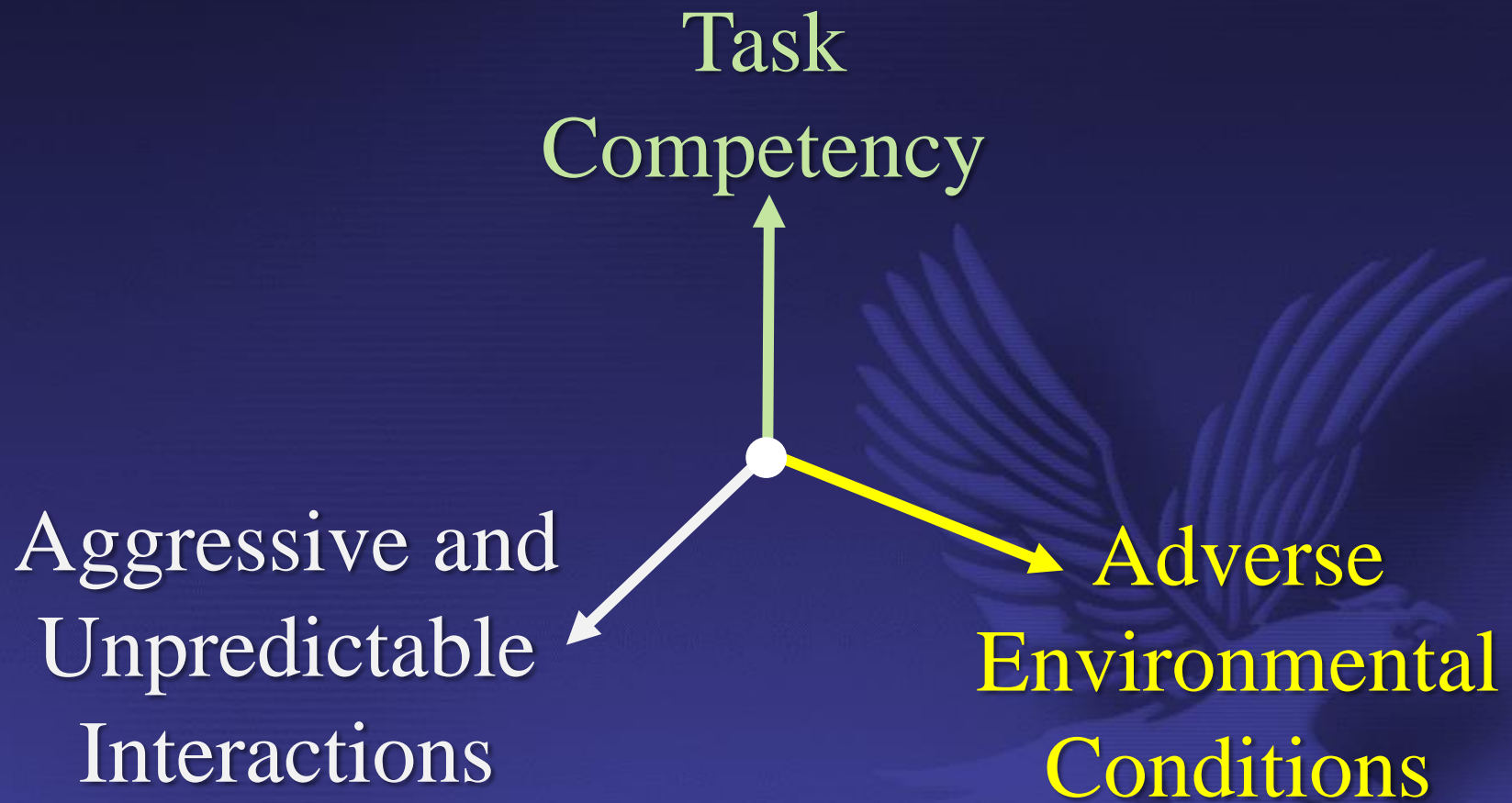
- Detects loss of traction, automatically applies brakes to re-gain control
- Required starting in 2012
- 2006 Insurance Institute for Highway Safety (IIHS) study:
 - ESC reduces the likelihood of all fatal crashes by 43%, fatal single-vehicle crashes by 56%, and fatal single-vehicle rollovers by 77–80%

Greater Levels of Vehicle Autonomy are on the Way

- Backup collision warning and braking
- Automatic park assist
- Lane departure warning
- Blind spot detection
- Adaptive cruise control
- Emergency braking to avoid collision

What is the motivation for this new technology?

Full Autonomy - What's Hard Beyond Task Competency



Autonomous Systems to Improve Airport Safety, Security and Compliance

Objective

Develop automated system for inspecting:

- Fence Integrity (FAR 139.335)
- Wildlife Incursions (FAR 139.337)
- Paved Areas (FAR 139.305)



Autonomous Security Patrol

Sensors suite:

Velodyne Laser Range Finder

GPS/INS

Cameras

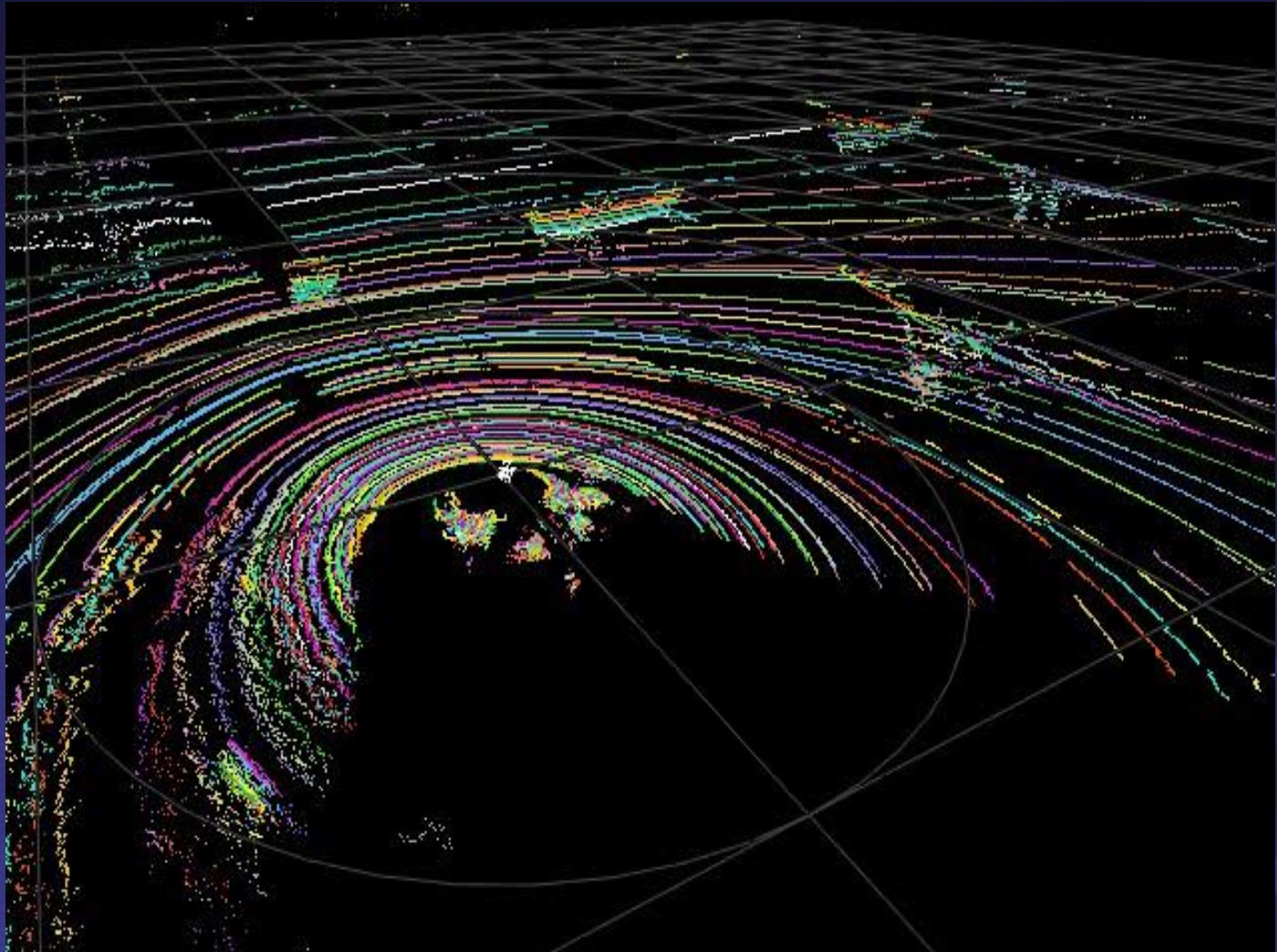


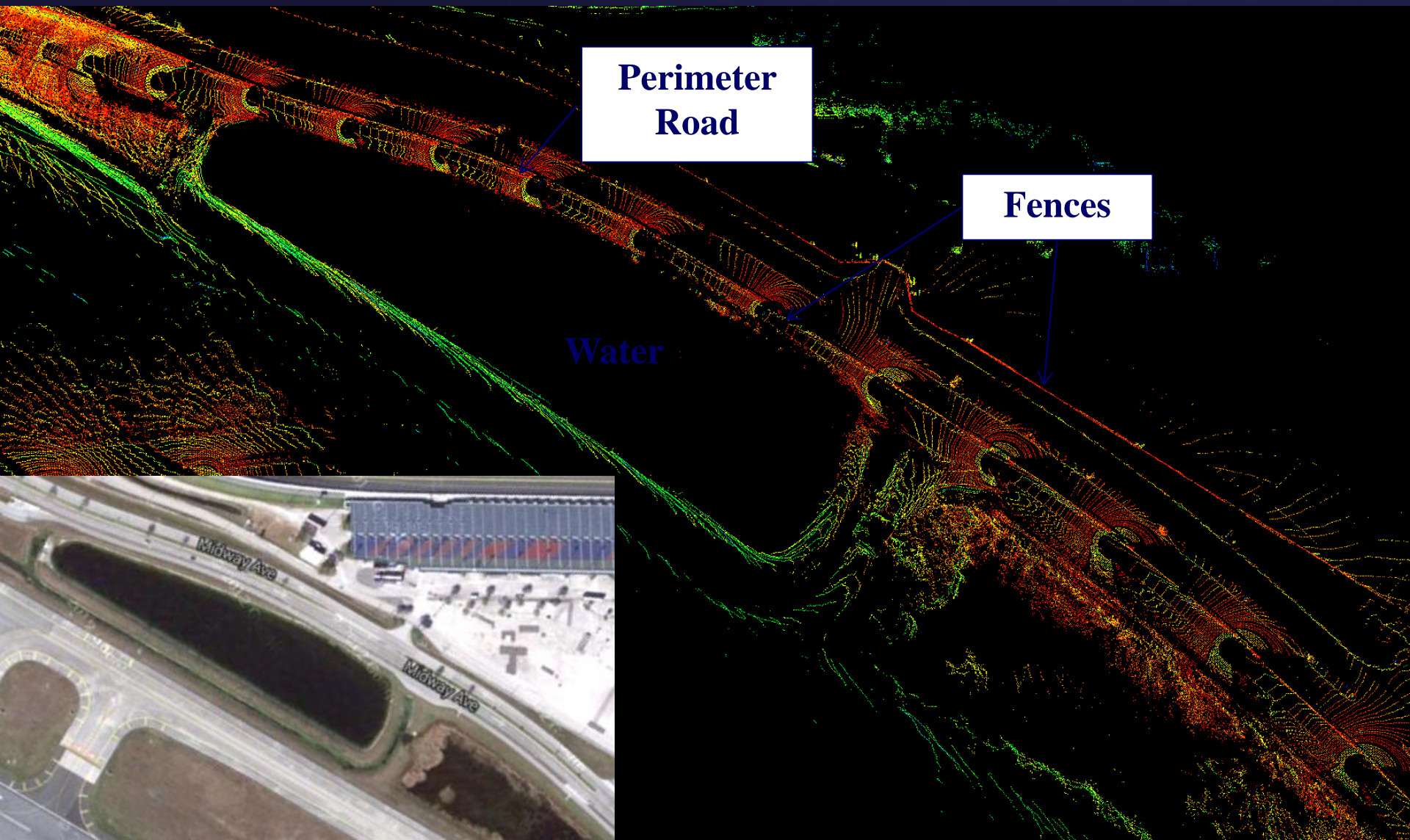
ERAU Proprietary - Government
Distribution Only
Aeronautical University

Autonomous Driving Map for 1st Test Run, August 9, 2013, Distance Traveled: 2384m (1.48 miles)



Velodyne Laser Scanner Data





Marsupial Sub-vehicle



Autonomous Mowing System: Motivation



Mower Operating Modes

(1) Driven by on-board operator

(2) Remote Control

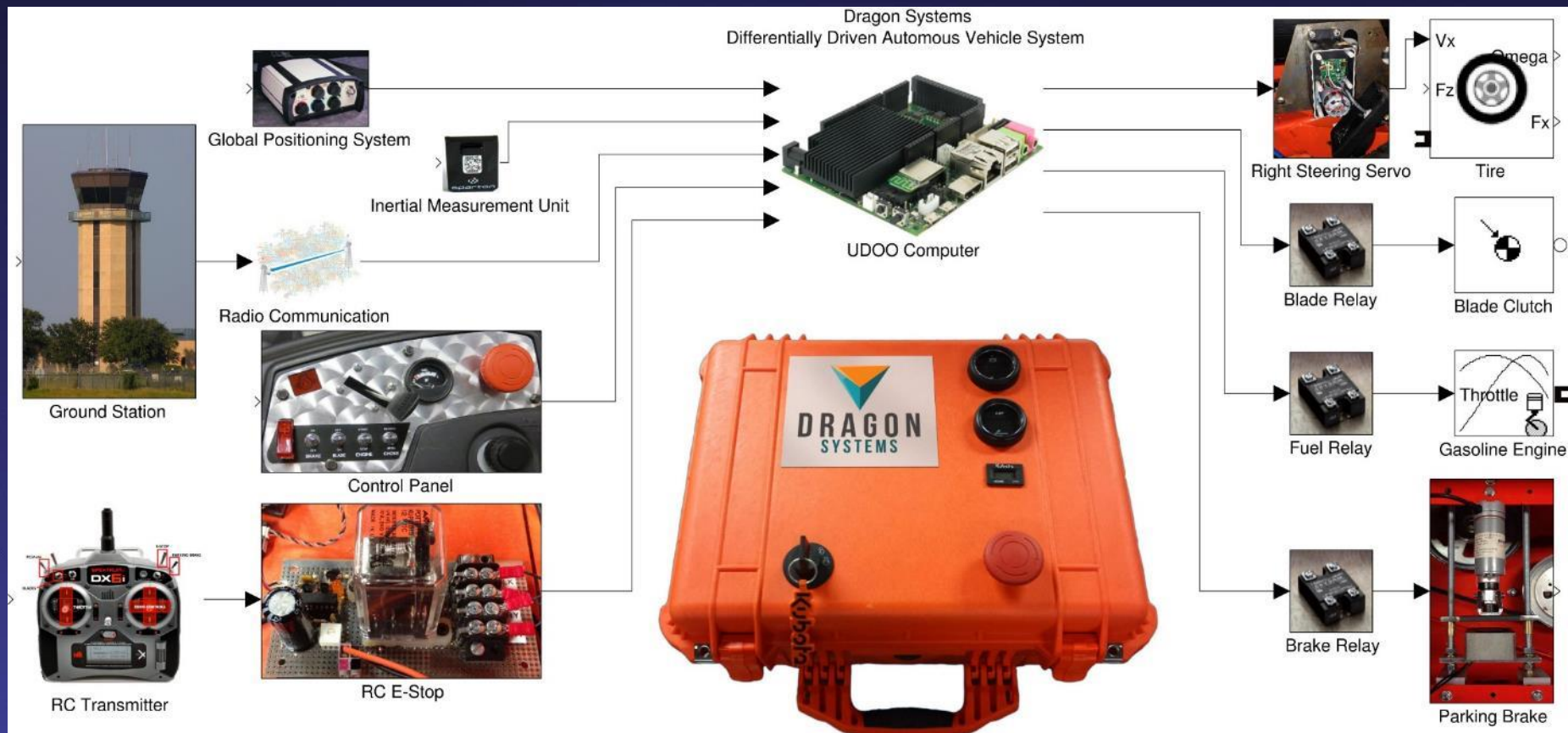
- drive-by-wire conversion
- operated via a handheld remote control

(3) Autonomous

- Fail-safe safety systems
- Sensor suite for perception and control
- Communication with tower and security



Mower System Design



Student Robotics Activities

Robotics Association at Embry Riddle

- The largest student organization on campus (380 members)
- Top 5 finishes in RoboBoat, SUAS, IGVC and Maritime RobotX in 2014
- College and campus-wide participation



AUVSI Foundation Collegiate Competitions

1. International Aerial Robotics Competition (IARC)
2. Intelligent Ground Vehicle Competition (IGVC)
3. Student Unmanned Aerial Systems Competition (SUAS)
4. RoboSub
5. RoboBoat
6. Maritime RobotX Challenge

Intelligent Ground Vehicle Competition



Thanks

